Re: ET Docket No. 02-135

Comments on Issues Related to Commission's Spectrum Policies
(for Interference in particular)

Submitted by
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Spectrum is similar to roads and highways, and wireless communication is a kind of traffic system where traffic is on spectrum, invisible to the human being.

If a public traffic system needs rules and disciplines, then wireless communications needs them, too. Unfortunately, people cannot see wireless traffic so the interference among wireless traffic becomes a dispute issue always.

In any city, we have roads for pedestrians, for bicycles, for slow vehicles and trucks, and for fast vehicles. We can share the roads for both slow and fast vehicles to increase the utilization of roads, but the fast vehicles are always interfered with by the slower vehicles, which decrease the traffic flow for the vehicles.

Now, the efficiency of providing the traffic roads is to:

- Increase the utilization of the roads, or
- Increase the traffic flow of the vehicles.

This analogy can be applied to the spectral efficiency. Then the sharing spectrum policy may not necessarily help in increasing the spectral efficiency. Therefore, economists may miss this view.

In communication systems, some systems are more highly susceptible to interference than other systems. The former can be a high capacity system because it can tolerate more interference, either generated by more users in its own system (increase efficiency), or by the foreign systems (create sharing alternatives).

Then, the sharing alternative usually starts the dispute at FCC.
Increasing spectrum efficiency and reducing interference are two related topics. Today, several new innovative TDD systems can reduce the interference effectively and can be good candidates for spectrum efficiency systems.

Now, I will try to answer the following questions stated in the "Interference Protection" sesction:

7). Define the "interference" and "harmful interference".

Interference that we are interested in is the unintentional interference. The interference can be generated by its own system called I_s or generated by a foreign system called I_a. The total interference is $I_s + I_a$. This interference level would affect the signal reception. Suppose that a system's receiver requires its carrier-to-interference level $C/(I+N) \geq A$, where N is the ambient noise and $I = I_s + I_a$.

When $C/(I_s + I_a + N) \leq A$, the system cannot be functional. At this time, I_s is the cap of the system capacity, I_a is the harmful interference. Since the interference has a large gray area from weak to strong, then the dispute starts at FCC.

8) Increased flexibility policy.

Some of the flexibility approach may cause harmful interference, some may not.

Flexibility – sharing the spectrum within an operator or multiple operators in the same or different locations (ground and air) and areas (space), in same or different subbands (frequency), and in same or different usage of time (time).

All of them can have harmful interference if among multiple users.

9) Explicit protections from harmful interference.

- Defining the power limit, carefully examining the shearing-spectrum systems.
- The auctioned spectrum owner is a primary licensee. Any new system operators should negotiate with the primary licensee. FCC may not be involved.

10) Commission's rules on power limits, coordination procedures and regulatory measures.

The rules can be updated to meet the future technology challenges.

11) Protect against harmful interference, affect innovation?

Now the most innovative systems are using spread spectrum systems. Therefore, one innovative system may not cause harmful interference, but several systems sharing the same spectrum will cause harmful interference. To monitor and discipline the spread spectrum systems is very hard.

12) Redefine the unacceptable or “harmful” interference?

Harmful interference is calculated from each individual system unless the system can be modified to reduce the harmful interference level. Any new rules defining harmful interference Level may only apply to the future systems while asking for FCC type acceptance.

13) New policy to address interference.

It will include the power limits, the filters of transmitter and receivers, and the linearity of the power amplifier.

14) Receiver standards or guidelines?

a. Using tighter filter skirt can cut down the interference level.
b. Based on the required C/I of legacy receiver.
c. The standards/guidelines should differ among the various radio services based on their systems.

15) My personal opinion:

If you have two parties, and both are primary licensees, FCC should be involved to resolve the interference issue.

If one party is a primary licensee, and the other is not, they should work out their issues by themselves.

16) The rules for interference that are based on economics?

Interference issue alone is a technical issue, not an economical issue. After understanding the technical issue, economists can find ways for economic balancing between the parties.

I am writing my comments in a rush, but I will attend the July 15, 2002, senior level discussion and workshop and hope to have a chance to express these comments in more detail.